

LISTING OF CLAIMS:

The present listing of claims replaces all prior listings or versions of claims in the present application.

1. (Currently Amended) A method for water hammerless opening of a fluid passage, ~~comprising the steps of:~~ characterized by that, with the method by which the

~~(a) providing a fluid passage is made open~~ openable by operation means of ~~an~~ the actuator operating type valve provided on the fluid passage ~~of a pipe passage, wherein the fluid passage has a~~ having the nearly constant pressure inside the pipe passage;

~~(b) moving a first the valve body of the actuator operating type valve is moved toward a the direction of the valve opening by increasing or decreasing the afore-mentioned driving input to an the actuator of the actuator operating type valve, wherein the driving input is being increased or reduced to a the first prescribed set value;~~ and

~~(c) holding the driving input to the actuator is held at the first afore-mentioned set value for a first short period of time;~~ and then, said

~~(d) further increasing or decreasing the driving input is further increased or reduced to move make the valve body to in a state of full valve opening so, thus the fluid passage is being opened without causing a water hammer.~~

2. (Currently Amended) A method for water hammerless opening of a fluid passage as claimed in Claim 1, wherein ~~the valve is it is so made that~~ a normally closed and pneumatic pressure operating type diaphragm valve, or a normally closed and pneumatic operating type diaphragm valve, wherein each of these diaphragm valves ~~which is of a the fixed capacity type wherein an with the inner capacity of the valve is not being changed when the valve is operated,~~ is employed for a valve.

3. (Currently Amended) A method for water hammerless opening of a fluid passage as claimed in Claim 1, wherein ~~it is so made that the~~ first period of time for the driving input to the actuator being held at the set value for a short period of time is made to be less than 1 second, and ~~at the~~ pressure rise value of the fluid passage is made to be within 10% of ~~at the~~ first pressure value before the valve is made to open.

4. (Currently Amended) A device for water hammerless opening of a fluid passage, ~~comprising; characterized by that it is so constituted that it comprised~~

(a) a valve comprising a valve body;

(b) an actuator disposed to drive the valve body;

(c) a vibration sensor removably fixed to the pipe passage on the upstream side of the valve;

(d) an electro-pneumatic conversion control device disposed to receive ~~ato which the~~ valve opening/closing command signal input is inputted, wherein the electro-pneumatic conversion control device comprises a data storage part, wherein ~~an and with which the~~ actuator operating pressure P_a inputted to the actuator is controlled by ~~at the~~ control signal S_c stored in advance in the data storage part; ~~in advance;~~ and

(e) a computation control device comprising ~~equipped with a comparison computation circuit,~~ wherein the comparison computation circuit is disposed to receive as input ~~at which the~~ vibration detecting signal P_r from the ~~af ore-mentioned vibration sensor,~~ the step pressure setting signal P_s to be supplied to the actuator, the step pressure holding time setting signal T_s , and the permissible upper limit vibration pressure setting signal P_{rm} are inputted, and wherein the comparison computation circuit compares the ~~with which the af ore-mentioned~~ vibration detecting signal P_r and the permissible upper limit vibration pressure setting signal

~~Prm are compared, and the afore-mentioned step pressure setting signal is adjusted by the comparison computation circuit so that, thus outputting the control signal Sc is outputted by the comparison computation circuit consisting of the afore-mentioned holding time setting signal Ts and adjusted step pressure setting signal Ps to the data storage part of the afore-mentioned electro-pneumatic conversion control device, wherein the control signal Sc comprises the holding time setting signal Ts and the adjusted step pressure setting signal Ps.~~

5. (Currently Amended) A device for water hammerless opening of a fluid passage as claimed in Claim 4, wherein ~~the~~ it is so constituted that a computation control device further comprises a step pressure setting circuit, a holding time setting circuit, a permissible upper limit vibration pressure setting circuit, a vibration pressure detecting circuit and ~~the~~ a comparison computation circuit; and when the vibration detecting signal Pr exceeds the permissible upper limit vibration pressure setting signal Prm immediately after ~~an~~ the actuator operating signal is step-changed, the step pressure setting signal Ps is adjusted toward ~~a~~ the rising direction, and when the vibration detecting signal Pr exceeds the permissible upper limit vibration pressure setting signal Prm immediately after the actuator operating pressure Pa is made to zero from the intermediate step operating pressure, the step pressure setting signal Ps is adjusted toward ~~a~~ the lowering direction.

6. (Currently Amended) A device for water hammerless opening of a fluid passage as claimed in Claim 4, wherein ~~the~~ it is so constituted that an electro-pneumatic conversion device comprises ~~the~~ a data storage part ~~that~~ which stores the control signal Sc from the computation control device, a signal conversion part, and an electro-pneumatic conversion part, ~~wherein an~~ the actuator operating pressure control signal Se is outputted from the signal conversion part to the electro-pneumatic conversion part based on ~~a~~ the control signal Sc'

stored in advance in the data storage part so that the pipe passage is opened without causing a
in advance with which no water hammer is caused.

7. (Currently Amended) A device for water hammerless opening of a fluid passage,
comprising: wherein it is so constituted that it comprises

(a) an actuator operating type valve installed on the fluid passage;

(b) an electro-pneumatic conversion device disposed to supply the 2-step actuator
operating pressure Pa to the actuator operating type valve;

(c) a vibration sensor removably fixed to the pipe passage on the upstream side of
the afore-mentioned actuator operating type valve; and

(d) a tuning box disposed to receive as input the vibration detecting signal
Pr detected through the vibration sensor is inputted and to output to the electro-pneumatic
conversion device from which the control signal Sc to control the step operating pressure
Ps' of the afore-mentioned 2-step actuator operating pressure Pa is outputted to the electro-
pneumatic conversion device, wherein the tuning box adjusts the control signal Sc so that the
output from the electro-pneumatic conversion device of the 2-step actuator operating pressure
Pa comprising of the step operating pressure Ps', which makes the vibration detecting signal
Pr nearly zero, from the electro-pneumatic conversion device by adjusting said control signal
Se.

8. (Currently Amended) A method for water hammerless opening of a fluid passage,
comprising the steps of: characterized by that, with the method for

(a) opening a fluid passage having for which a vibration sensor is removably fixed on
the upstream side of the actuator operating type valve installed on the fluid passage; and

~~(b) inputting a~~ the vibration detecting signal Pr ~~from the vibration sensor is inputted to~~
~~a~~ the tuning box₁; and then,

~~(c) inputting a~~ the control signal Sc from the tuning box ~~to a~~ is inputted to the electro-
pneumatic conversion device; and, thus the

~~(d) generating a 2-step actuator operating pressure Pa generated in the electro-~~
pneumatic conversion device ~~when the by the afore-mentioned control signal Sc is inputted,~~
~~and supplying the 2-step actuator operating pressure Pa to an being supplied to the actuator~~
~~operably connected to the actuator operating type valve so that the actuator operating type~~
valve is made ~~to open in a~~ the 2-step operation, ~~wherein the 2-step actuator operating pressure~~
 Pa to be supplied to the actuator and the vibration detecting signal are compared for ~~a~~ the
relative relationship of the two, and ~~when if~~ vibration is generated at ~~a~~ the time when ~~a~~ the first
step actuator operating pressure Pa rises, ~~a~~ the step operating pressure Ps' is lowered, and
~~when if~~ vibration is generated at ~~a~~ the time when ~~a~~ the second step actuator operating pressure
 Pa rises, the step operating pressure Ps' is raised, and the step operating pressure Ps' of the
step operating pressure Pa , to make ~~the said~~ vibration detecting signal Pr nearly zero₁ is
determined by repeating a plurality of adjustments of raising or lowering the afore-mentioned
step operating pressure Ps' so that the afore-mentioned actuator operating type valve is made
~~to open based on control signal Sc data on the control signal Sc when the 2-step operating~~
pressure Pa of the step operating pressure Ps' , to make generation of vibration nearly zero₁ is
outputted from the electro-pneumatic conversion device.

9. (Currently Amended) A method for water hammerless opening of a fluid passage,
~~comprising the steps of: characterized by that, with the method for~~

~~(a) opening a fluid passage having for which a vibration sensor is removably fixed on~~
~~a~~ the upstream side of ~~a~~ the actuator operating type valve installed on the fluid passage₁; and

(b) ~~inputting a~~ the vibration detecting signal Pr ~~to~~ ~~is inputted to the tuning box;~~ and then,

(c) ~~inputting a~~ the control signal Sc from the tuning box ~~to~~ ~~is inputted to the electro-~~
pneumatic conversion device; ~~and, thus the~~

(d) ~~generating a 2-step actuator operating pressure Pr generated in the electro-~~
pneumatic conversion device by the ~~when the~~ ~~fore-mentioned~~ control signal Sc ~~is inputted,~~
~~and supplying the 2-step actuator operating pressure Pa to~~ ~~an~~ ~~being supplied to the actuator~~
~~operably connected to the actuator operating type valve so that the actuator operating type~~
valve is made to open in ~~a~~ the 2-step operation, ~~wherein~~ the 2-step actuator operating pressure
Pa to be supplied to the actuator and the vibration detecting signal Pr are compared for ~~a~~ the
relative relationship of the two, and ~~when~~ ~~if~~ vibration is generated at ~~a~~ the time when ~~a~~ the first
step actuator operating pressure Pa drops, ~~a~~ the step operating pressure Ps' is raised, and
~~when~~ ~~if~~ vibration is generated at ~~a~~ the time when ~~a~~ the second step actuator operating pressure
Pa drops, the step operating pressure Ps' is lowered, and the step operating pressure Ps' of the
2-step operating pressure Pa, to make ~~the~~ ~~said~~ vibration detecting signal Pr nearly zero, is
determined by repeating a plurality of adjustments of raising or lowering the ~~fore-mentioned~~
step operating pressure Ps' so that the ~~fore-mentioned~~ actuator operating type valve is made
to open based on control signal SC ~~data on the control signal Se~~ when the 2-step operating
pressure Pa of the step operating pressure Ps', to make generation of ~~said~~ vibration nearly
zero, is outputted from the electro-pneumatic conversion device.

10. (Currently Amended) A method for water hammerless opening of a fluid passage as
claimed in Claim 8, ~~or Claim 9~~ wherein ~~it is so made that the vibration sensor and the tuning~~
box ~~are removeable, and are can be removed after the~~ control signal Sc ~~data on the control~~
signal Se ~~at a~~ the time of outputting the 2-step operating pressure Pa, with which generation of

vibration is nearly zero, are inputted to ~~at~~the memory storage of the electro-pneumatic conversion device.

11. (Currently Amended) A method for water hammerless opening of a fluid passage as claimed in Claim 8, ~~or Claim 9~~ wherein ~~it is so made that the~~ vibration sensor is provided at ~~at~~the position on the upstream side within 1000mm from the place where the actuator operating type valve is installed on the fluid passage.

12. (Currently Amended) A method for water hammerless opening of a fluid passage as claimed in Claim 8, ~~or Claim 9~~ wherein ~~it is so made that the~~ step operating pressure holding time t of the 2-step operating pressure Pa is set at less than 1 second.

13. (Currently Amended) A method for supplying a chemical solution, comprising the steps of: ~~wherein it is so made that with which~~

(a) supplying a fluid to ~~is supplied to the~~ fluid passage on ~~at~~the downstream side of an actuator operating type valve installed on the fluid passage by opening the fluid passage using ~~by means of the actuator operating type valve, wherein installed on the fluid passage has~~having a nearly constant internal pressure therein, and the fluid is a chemical solution; wherein opening of the fluid passage includes the steps of ~~is used for a fluid, and~~

i. firstly, moving ~~at~~the valve body of the actuator operating type valve ~~is moved~~ toward ~~at~~the direction of valve opening by increasing or decreasing a ~~the afore-~~mentioned driving input to ~~an~~the actuator to the prescribed set value, wherein the actuator is operably connected to the actuator operating type valve; and

ii. secondly, holding the actuator driving input ~~is held at the afore-mentioned~~ set value for a first ~~short~~ period of time; and then, said

~~thirdly, further increasing or decreasing the driving input is further increased or decreased to move the valve body of the valve to make a valve in a state of full opening so that a water hammer does not occur at the time of the valve is being~~
opened.

14. (NEW) A method for supplying a chemical solution as claim in Claim 13, wherein the first period of time is less than 1 second.

15. (NEW) A method for water hammerless opening of a fluid passage as claimed in Claim 9, wherein the vibration sensor and the tuning box are removeable, and are removed after the control signal Sc data at a time of outputting the 2-step operating pressure Pa, with which generation of vibration is nearly zero, are inputted to a memory storage of the electro-pneumatic conversion device.

16. (NEW) A method for water hammerless opening of a fluid passage as claimed in Claim 9, wherein the vibration sensor is provided at a position on the upstream side within 1000mm from where the actuator operating type valve is installed on the fluid passage.

17. (NEW) A method for water hammerless opening of a fluid passage as claimed in Claim 9, wherein a step operating pressure holding time t of the 2-step operating pressure Pa is set at less than 1 second.